884

INSTRUCTION MANUAL

SIGNAL SOURCE 6457

SERIAL No. 111.

mi Sanders

MP MASTER
MA23594

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REPAIRS

When returning instruments for repair, or for any other reason, please contact this Company for shipping instructions. To expedite repair service, it is important to provide type number, serial number, and a detailed description of the reason for the return of the instrument.

SPECIFICATION CHANGES

The Company reserves the right to change any specifications noted herein without prior notice.

MARCONI INSTRUMENTS LTD – SANDERS DIVISION

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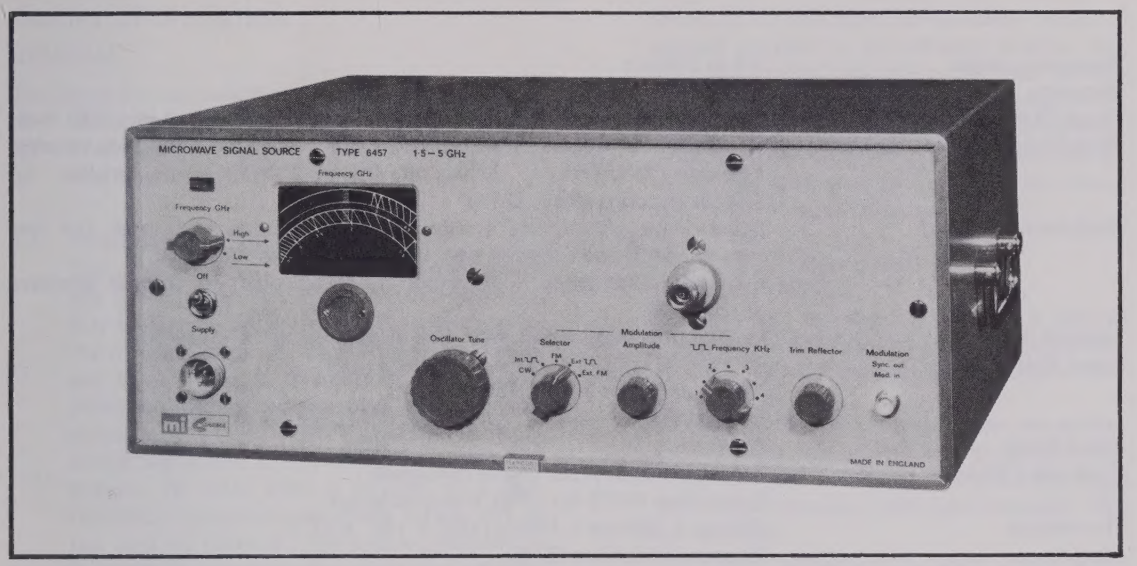
SIGNAL SOURCE 6457

1·5—5·0 GHz



SECTION 1

DESCRIPTION

The Signal Sources are designed to provide the widest possible frequency coverage with the klystrons used. They provide highly stable microwave signals suitable for use in laboratories and test departments.
The important design features are:-

1. Super wide range continuous frequency coverage.
2. Single knob control of frequency.
3. Direct reading 1% frequency scale.
4. Full electronically stabilised resonator and reflector supplies.
5. Internal square wave and frequency modulation circuits.
6. Internal sync output and provision for external modulation inputs.

SECTION 2

SPECIFICATION

Frequency range:	1·5 to 5·0GHz
Accuracy	±1% of dial reading
Power Output C.W.	Typically better than 5mW and up to 100mW in centre band into 50Ω load.
Modulation internal	Square Wave: Frequency variable between 1 & 4KHz. Amplitude variable. Frequency Modulation: Sweep rate approx. 1·2KHz. Sweep variable. F.M. deviation typically 0·1%.
Modulation external	Square Wave: Amplitude greater than 40 volts peak to peak but not exceeding 100 volts peak to peak for 100% modulation. Frequency Modulation: Waveform up to 50 volts peak to peak sinewave or sawtooth.
Leakage isolation	Greater than 80dB down, with case in position, at 12″ distance.
Input Voltage	110 to 125 volts in 5 volt increments 220 to 250 volts in 10 volt increments 50 to 400Hz
Input Power	80 Watts
Frequency Stability	Better than 0·02% per degree centigrade Better than 0·01% for ±10% mains variation
Dimensions	450mm x 365mm x 195mm (18″ x 14⅜″ x 7⅝″)
Weight	Approx. 14·5 Kilos (32lb)

SECTION 3

OPERATIONAL CONTROLS

SWITCHES & KNOBS

3.1. SUPPLY (line) switch
All heater voltage applied to tubes and H.T. to stabilising circuits. E.H.T. rises first on the reflector circuit and is followed by the resonator potential.

3.2. OSCILLATOR TUNE control
Rotation tunes oscillator cavity and determines the operating frequency (in conjunction with FREQUENCY GHz switch)—as indicated on the frequency dial, to an accuracy of 1%.

3.3. MODULATION SELECTOR switch
Switch which selects:-CW, Internal Square Wave modulation, Internal Frequency modulation, External Square Wave modulation, or External Frequency modulation.

3.4. MODULATION ⎍⎍⎍ FREQUENCY control
Rotation adjusts frequency of square wave modulation between 1 and 4KHz.

3.5. MODULATION AMPLITUDE control
Adjusts amplitude of the internal sawtooth waveform applied to the reflector giving control of the F.M. sweep width when the MODULATION switch is at F.M. Adjusts square wave amplitude which is applied to the reflector clamping network when the MODULATION switch is at Int. ⎍⎍⎍.

3.6. TRIM REFLECTOR control
Gives small ranges of adjustment for optimising voltage against loading conditions.

3.7. R.F. OUTPUT
Female Type N probe. Withdrawal into the cut-off tube attenuates output level.

3.8. MODULATION SYNC. OUT. MOD. IN
BNC socket for external modulation voltage input or internal modulation synchronising output.

3.9. SUPPLY
3 pin supply/line input point, Type Cannon WK3-32SL. Input voltage set by input voltage selector at the rear of the instrument.

SECTION 4

THEORY OF OPERATION

GENERAL

The Signal Source is divided into three sections
(a) Oscillator cavity
(b) The Modulators
(c) The Stabilised Power Supplies.

4.1. THE OSCILLATOR CAVITY

The oscillator cavity is a high precision coaxial line cavity effectively open circuit at one end (klystron end) and shorted at the other end by the movable piston. The klystron, which is plugged in at the open circuit end, has its D.C. potentials introduced via high isolation lead throughs to prevent R.F. leakage. A non-contacting piston is employed to vary the frequency. Its drive shaft is coupled to a high resolution potentiometer which forms part of the tracking network. The tracking network is designed to automatically adjust the reflector potential to that which is required for optimum operation of the klystron.

Switching devices, coupled to the cavity tuning control, abruptly alter the potential when changing from one reflector mode to another. An adjustable mode suppression system, coupled to the frequency scale, ensures continuous frequency coverage.

4.2. THE MODULATORS

The modulation waveforms from the power supply include square wave, at a frequency variable between 1KHz and 4KHz and saw-tooth at a fixed frequency of approximately 1·2KHz The square wave is derived from a conventional multi-vibrator circuit and the frequency variation is effected by means of a wire wound potentiometer. In the case of square wave modulation the output from the multivibrator is fed into a pentode V5 which squares the waveform even further and provides a comparatively low output impedance.

The height of the square wave may be varied between approximately 50V p-p and 4V p-p. The square wave is clamped to the reflector and is D.C. restored in the negative direction, i.e. the square wave excursion will not go more positive than the reflector potential. It is generally unnecessary to alter the amplitude of the square wave modulation unless the height of the waveform happens to be exactly the same as the voltage difference between two successive reflector modes.

External modulation may be applied to the circuit for synchronisation purposes:- the same coaxial socket covers both applications.

The sawtooth waveform, which is used for frequency modulating the klystron, is derived from a comparatively conventional Miller transitron timebase. In this case, the timebase output is applied directly to the reflector without any D.C. restoration since this is the most convenient way of frequency sweeping the klystron. A control of modulation amplitude is essential since the voltage applied to the reflector will be directly proportional to the frequency excursion of the klystron output.

THE STABILISED POWER SUPPLIES

4.3. CATHODE SUPPLY

The cathode, or resonator voltage is derived from a bridge rectifying circuit which is smoothed by a conventional reservoir capacitor and resistance network.

The Klystron's resonator electrodes are earthy, and therefore the cathode voltage appears negative with respect to earth. The cathode voltage varies with frequency from approximately −250 to −350 volts.

The circuit consists of a power triode series valve V1 and double triode feedback amplifiers V2 and V3. In valve V3 only one half is used as an amplifier whilst the other half is strapped as a diode to offset the heater drift in the first half, which would otherwise result in an apparent overcompensation of output potential with variation of mains voltage.

The reflector supply is used as the reference voltage and appears via the cathode voltage setting potentiometer RV1 at V3b cathode. The error signal is highly amplified by V3a and fed to the grid of one half of the double triode V2. This half acts as a cathode follower driving the second half of the valve at its cathode. Its other grid is held at a fixed potential determined by the two high stability resistors R3 and R4. An amplified in phase signal appears at the anode of the second half of V2. This signal is applied directly to the grid of series valve V1 which restores the voltage output to the value set by RV1. The potentiometer RV1 is ganged to RV5 and the cavity tuning mechanism to produce a varying cathode potential.

4.4. REFLECTOR SUPPLY

This supply is of a series parallel valve design utilising two valves in the parallel path and featuring high feed back gain. It provides a D.C. output which has an extremely low ripple voltage (below ·5%mV R.M.S.) and high D.C. stability of about 0·03%.

The output from the reflector voltage stabilising circuit is a fixed potential which is applied to the tracking potentiometer (connected to the klystron cavity) so that the potential applied to the klystron follows the required law. Microswitches coupled to the oscillator cavity drive mechanism switch fixed potentials corresponding to the requirements of the different reflector modes used.

SECTION 5

MAINTENANCE

WARNING - POTENTIALS CLOSE TO 1000 VOLTS EXIST BETWEEN CHASSIS AND SOME TERMINALS. PROCEED WITH GREAT CARE.

5.1. REMOVAL OF THE UNIT FROM THE CABINET

5.1.1. Switch off SUPPLY (line) switch and disconnect input cable.

5.1.2. Remove the rear panel held by 4 x 4BA screws.

5.1.3. Remove the 4 plastic feet and 4 x 4BA screws near the feet.

5.1.4. Withdraw the casing rearwards.

5.2. REPLACEMENT OF KLYSTRON

WARNING THE KLYSTRON IS A VERY DELICATE DEVICE AND NO EXCESSIVE FORCE SHOULD BE USED IN THIS OPERATION.

5.2.1. Unscrew the cap at the end of the cavity.

5.2.2. Carefully withdraw the klystron shroud with the klystron, leaving the circular contact *in the cavity.*

5.2.3. Separate the shroud from the klystron, and remove the valve base and heat sink from the old klystron.

5.2.4. Mount the heat sink, and connect the valve base, to the new klystron.

5.2.5. Seat the shroud on the klystron, and insert this assembly into the cavity.

5.2.6. Before replacing the end cap, the 8BA hex set screw should be unlocked and the nylon screw unscrewed ¼".

5.2.7. The cap may now be screwed home, and the nylon screw turned gently until some resistance is felt. Lock the nylon screw in this position with the 8BA hex set screw. Do not use excessive locking force.

5.2.8. Connect the supply and switch on, select the F.M. position, turn the MODULATION AMPLITUDE control fully clockwise and feed the R.F. output to a crystal detector and oscilloscope display. Turn the TRIM REFLECTOR control to the central position. If, when the MODULATION AMPLITUDE control is adjusted to just accommodate the correct mode, the the mode is not approximately central, some adjustments of the tracking network will be necessary—proceed as below:-

5.3. KLYSTRON TRACKING PROCEDURE

Ancillary equipment required

(a) Sensitive D.C. Oscilloscope
(b) Coaxial crystal detector with built in D.C. return.
(c) Wide band coaxial Frequency Meter.
(d) D.C. voltmeter of high impedance.

5.3.1. Connect the crystal detector to the R.F. output socket, connect the crystal output to the oscilloscope, and trigger or synchronise from the MODULATION SYNC. OUT. MOD. IN. socket. Set the voltmeter to the 500 volt range, connect the positive lead to the klystron's cathode (NOT EARTH) and the negative lead to the reflector terminal.

5.3.2. Set MODULATION SELECTOR switch to F.M. set the TRIM REFLECTOR potentiometer to its central position. Switch on the equipment and allow a few minutes to warm up.

5.3.3. At 3·0GHz on the 'Low' Range set FREQUENCY dial to agree with the output frequency of the cavity. (Remove panel disc that is coincident with the dial centre for access).

5.3.4. Rotate the FREQUENCY dial to 1·5 GHz. Adjust RV8 (R49) so as to centralise the reflector mode trace, adjust (if necessary) the MODULATION AMPLITUDE control so that the mode trace almost fills the oscilloscope sweep. Adjust the probe penetration so as to get a moderate display amplitude on the oscilloscope without overloading the cavity. The reflector voltage read by the voltmeter is about 80 volts.

5.3.5. Rotate the FREQUENCY dial to 2·3 GHz. Adjust RV9 (R53) so as to centralise the reflector mode trace (if necessary reset the probe penetration and the MODULATION AMPLITUDE). The reflector voltage is about 220 volts.

5.3.6. Switch the voltmeter to the highest range (preferably to an open circuit position) and repeat the above two operations (5.3.4. and 5.3.5.) several times. (The two controls RV8 and RV9 are interdependent).

5.3.7. Switch the voltmeter back to the 500V range, and rotate the FREQUENCY dial to 2·4 GHz. Adjust RV6 (R55) so as to centralise the reflector mode trace, if necessary re-setting the probe penetration and/or the MODULATION AMPLITUDE control. The reflector voltage is about 80 volts.

5.3.8. Rotate the FREQUENCY dial to 3·5 GHz. Adjust RV7 (R68) so as to centralise the reflector mode trace. If necessary re-setting the probe penetration and/or the MODULATION AMPLITUDE control. The reflector voltage is about 220 volts.

5.3.9. Switch the voltmeter to the highest range (preferably to an open circuit position) and repeat 5.3.7. & 5.3.8. several times.

NOW switch to 'High' range.

5.3.10. Rotate the dial to 3·3 GHz. Adjust RV10 (R52) so as to centralise the reflector mode trace. If necessary re-setting the probe penetration and/or the MODULATION AMPLITUDE control. The reflector voltage is about 180 volts.

5.3.11. Rotate the FREQUENCY dial to 3·9 GHz. Adjust RV11 (R51) so as to centralise the reflector mode trace. If necessary re-setting the probe penetration and/or the MODULATION AMPLITUDE control. The reflector voltage is about 250 volts.

5.3.12. Switch the voltmeter to the highest range (preferably to an open circuit position) and repeat 5.3.10. & 5.3.11. several times.

5.3.13. Rotate the FREQUENCY dial to 4·2 GHz. Adjust RV12 (R54) so as to centralise the reflector mode trace. If necessary re-setting the probe penetration and/or the MODULATION AMPLITUDE control. The reflector voltage is about 160 volts.

5.3.14. Rotate the FREQUENCY dial to 5·0 GHz. Adjust RV13 (R50) so as to centralise the reflector mode trace. If necessary re-setting the probe penetration and/or the MODULATION AMPLITUDE control. The reflector voltage is about 220 volts.

5.3.15. Switch the voltage to the highest range (preferably to an open circuit position) and repeat 5.3.13. & 5.3.14. several times.

5.3.16. Check the accuracy of the FREQUENCY dial at several points in the band and reset the dial to give the minimum frequency error.

5.3.17. Replace the instrument in its case.

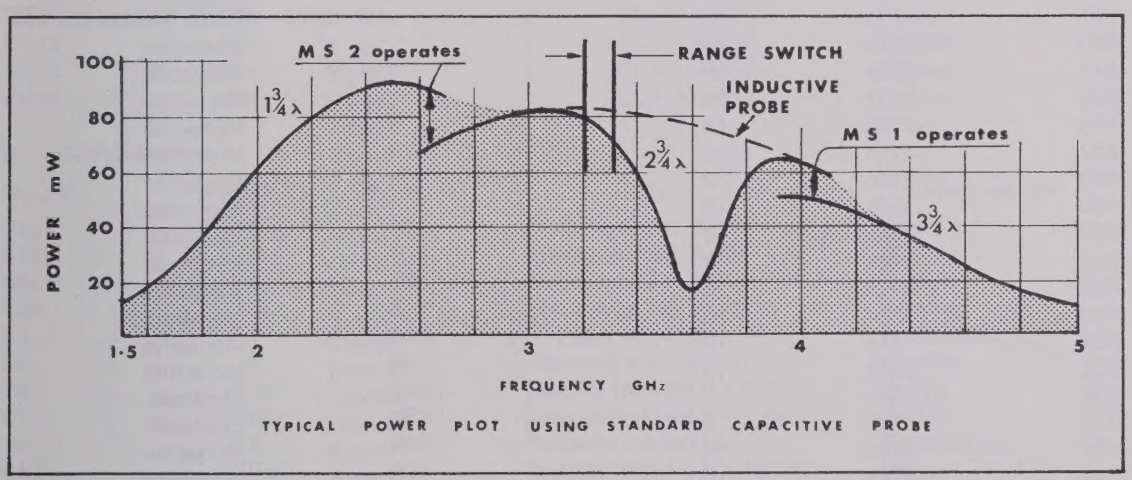
If any of the following conditions occur (assuming the correct supplies are reaching the klystron), the instrument must be returned to the manufacturer for rectification.

(a) Broken klystron (some glass could still be in the cavity)

(b) Klystron replaced, but unit fails to give continuous coverage (individual mis-alignment in the gun structure of klystron resulting in 'holes')

(c) Erratic performance (dirt could have found its way into the cavity).

Unauthorised tampering with the sealed screws on the cavity may result in damage to the cavity—and will invalidate the warranty.



TYPICAL POWER PLOT USING STANDARD CAPACITIVE PROBE

MICROWAVE SIGNAL SOURCE TYPE 6457

SPARES ORDERING SCHEDULE

1. RESISTORS

Cct. ref.	Value, Ω	Tolerance, %	Rating, W	Type	Manufacturer
R1	100	5	6	W.W. LG75	Radio Resistor Co. Ltd.
R2	1k	5	6	W.W. LG75	Radio Resistor Co. Ltd.
R3	100k	10	1	Type Y	Morganite
R4	47k	10	½	Type S	Morganite
R5	100k	10	½	Type S	Morganite
R6	1M	10	½	Type S	Morganite
R7	470k	10	½	Type S	Morganite
R8	100k	10	½	Type S	Morganite
R9	220k	10	½	Type S	Morganite
R10	110k	2	1	Oxide	Electrosil
R11	12M	5	½	RSX3	G.A.S. Palmer & Co.
R12	120k	5	½	RSX3	G.A.S. Palmer & Co.
R13	120k	5	½	RSX3	G.A.S. Palmer & Co.
R14	12M	5	½	RSX3	G.A.S. Palmer & Co.
R15	100k	10	½	Type S	Morganite
R16	2·2M	10	½	Type S	Morganite
R17	1·5k	10	½	Type S	Morganite
R18	39k	10	1	Type Y	Morganite
R19	1k	5	6	W.W. LG75	Radio Resistor Co. Ltd.
R20	15k	10	½	Type S	Morganite
R21	1M	10	½	Type S	Morganite
R22	1k	5	6	W.W. LG75	Radio Resistor Co. Ltd.
R23	220k	10	1	Type Y	Morganite
R24	220k	10	1	Type Y	Morganite
R25	1k	10	2	Type O	Morganite
R26	220k	10	½	Type S	Morganite
R27	220k	10	½	Type S	Morganite
R28	100	10	½	Type S	Morganite
R29	220k	10	½	Type S	Morganite
R30	150k	2	1	Oxide	Electrosil
R31	100k	2	1	Oxide	Electrosil
R32	470k	10	½	Type S	Morganite
R33	100	10	½	Type S	Morganite
R34	56k	10	½	Type S	Morganite
R35	330k	10	½	Type S	Morganite
R36	330k	2	1	Oxide	Electrosil
R37	47k	2	1	Oxide	Electrosil
R38	470k	10	½	Type S	Morganite
R39	470k	10	½	Type S	Morganite
R40	100k	2	1	Oxide	Electrosil
R41	130k	2	1	Oxide	Electrosil
R42	47k	2	1	Oxide	Electrosil
R43	2·2M	10	½	Type S	Morganite
R44	10k	10	½	Type S	Morganite
R45	1M	10	½	Type S	Morganite
R46	1k	10	½	Type S	Morganite
R47	470k	10	½	Type S	Morganite
R48	220k	2	1	Oxide	Electrosil
R49	1k	2	1	Oxide	Electrosil
R50	27k	2	1	Oxide	Electrosil
R51	47k	2	1	Oxide	Electrosil
R52	160k	2	1	Oxide	Electrosil
R53	110k	2	1	Oxide	Electrosil
R54	130k	2	1	Oxide	Electrosil
R55	10k	2	1	Oxide	Electrosil
R56	47k	2	1	Oxide	Electrosil
R57	100k	2	1	Oxide	Electrosil
R58	200k	2	1	Oxide	Electrosil

Cct. ref.	Value, Ω	Tolerance, %	Rating, W	Type	Manufacturer
R59	1M	2	1	Oxide	Electrosil
R60	390k	2	1	Oxide	Electrosil
R61	82k	2	1	Oxide	Electrosil
R62	120k	2	1	Oxide	Electrosil
R63	100k	2	1	Oxide	Electrosil
R64	82k	2	1	Oxide	Electrosil
R66	43k	2	1	Oxide	Electrosil
R67	4·5M	2	½	2 HS 3	Radio Resistor Co. Ltd.
R68	200k	2	1	Oxide	Electrosil
R69	120k	5	½	RSX3	G.A.S. Palmer & Co.
R70	1k	10	½	Type S	Morganite

2. RESISTORS VARIABLE

Cct. ref.	Value, Ω	Rating, W	Type	Manufacturer
RV1	50k	3	CLR 4001/11	Colvern
RV2	100k	3	CLR 4001/11	Colvern
RV3	10k	3	CLR 4001/11	Colvern
RV4	5k	1	10	S.T.C.
RV5	200k	12	Part of cavity assembly	FLANN
RV6	50k	1	CLR 1106/95	Colvern
RV7	50k	1	CLR 1106/95	Colvern
RV8	50k	1	CLR 1106/95	Colvern
RV9	50k	1	CLR 1106/95	Colvern
RV10	50k	1	CLR 1106/95	Colvern
RV11	50k	1	CLR 1106/95	Colvern
RV12	50k	1	CLR 1106/95	Colvern
RV13	50k	1	CLR 1106/95	Colvern
RV14	25k	3	CLR 4001/11	Colvern

3. CAPACITORS

Cct. ref.	Value, μF*	Rating, V	Type	Manufacturer
C1a	16	500	Electrolytic BR 3530	Dubilier
C1b	16	500	Electrolytic BR 3530	Dubilier
C2a	16	500	Electrolytic BR 3530	Dubilier
C2b	16	500	Electrolytic BR 3530	Dubilier
C3	0·1	400	Polyester HB 410/4	Roedenstein
C5	8	500	Electrolytic BR 5166	Dubilier
C6	27pF	400	Ceramic from kit HY 104.87	Philips
C7	39pF	400	Ceramic from kit HY 104.87	Philips
C8	0·022	400	Polyester HB 322/4	Roedenstein
C10	470pF	400	Ceramic from kit HY 104.87	Philips
C11	0·01	750	Ceramic "Hi-k"	Radiospares
C12	0·022	1000	Polyester HX 322/10	Roedenstein
C13	0·022	1000	Polyester HX 322/10	Roedenstein
C14	8	500	Electrolytic BR 5166	Dubilier
C15	8	500	Electrolytic BR 5166	Dubilier
C16	16	500	Electrolytic BR 3530	Dubilier
C17	16	500	Electrolytic BR 3530	Dubilier
C18	0·1	100	Polyester PMA-1 M100	S.T.C.
C19	0·1	630	Polyester HB 410/6	Roedenstein
C20a	16	500	Electrolytic BR 3530	Dubilier
C20b	16	500	Electrolytic BR 3530	Dubilier
C21	1	400	Polyester HB 510/4	Roedenstein
C22	0·1	400	Polyester HB 410/4	Roedenstein
C23	25,000	10	Electrolytic KA 20 30	Hunts

*except where otherwise shown

4. TRANSFORMER

T1	GR 58019	Gardners

5. VALVES

Cct. ref.			Manufacturer
V1	A2293		M.O. Valve
V2	12AX7		Mullard
V3	12AX7		Mullard
V4	12AU7		Mullard
V5	EF91		Mullard
V6	A2293		M.O. Valve
V7	12AX7		Mullard
V8	85A2		Mullard
V9	12AX7		Mullard
V10	12AT7		Mullard
V11	6BL6	Klystron	Ratheon

6. DIODES

D1 to D17 inc.	BYX 10	Mullard
D18	Klystron Heater Rectifier Bridge Type 1B20K05	Texas

7. FUSES

F.S.1.	2A 1¼"x ¼" Glass Fuse	Bulgin
F.S.2.	2A 1¼"x ¼" Glass Fuse	Bulgin
F.S.1.	Twin Fuseholder F26/3	Bulgin
F.S.2.	Twin Fuseholder F26/3	Bulgin
F.S.3.	250mA 1¼"x ¼" Glass Fuse	Bulgin
F.S.3.	Printed Circuit Fuseholder 8963 PC	Bulgin
F.S.4.	250mA 1¼"x ¼" Glass Fuse	Bulgin
F.S.4.	Printed Circuit Fuseholder 8963 PC	Bulgin

8. SWITCHES

S1	Supply switch D.P.S.T.	S.267	Bulgin
S2	Wafer	Specification No.99474 JKM 3	N.S.F.
S3	Wafer	Specification No.99476 JKM 1	N.S.F.

9. MICROSWITCHES

M.S.1.	Double D.P.D.T.	Type M1	Burgess
M.S.2.	Double D.P.D.T.	Type M1	Burgess

10. SOCKETS

SKT1	Supply Input 3 way	Type WK 3-32-SL	Cannon
SKT2	Modulation SYNC. OUT. MOD. IN.	B.N.C. UG/625B/U	Greenpan

11. PLUG

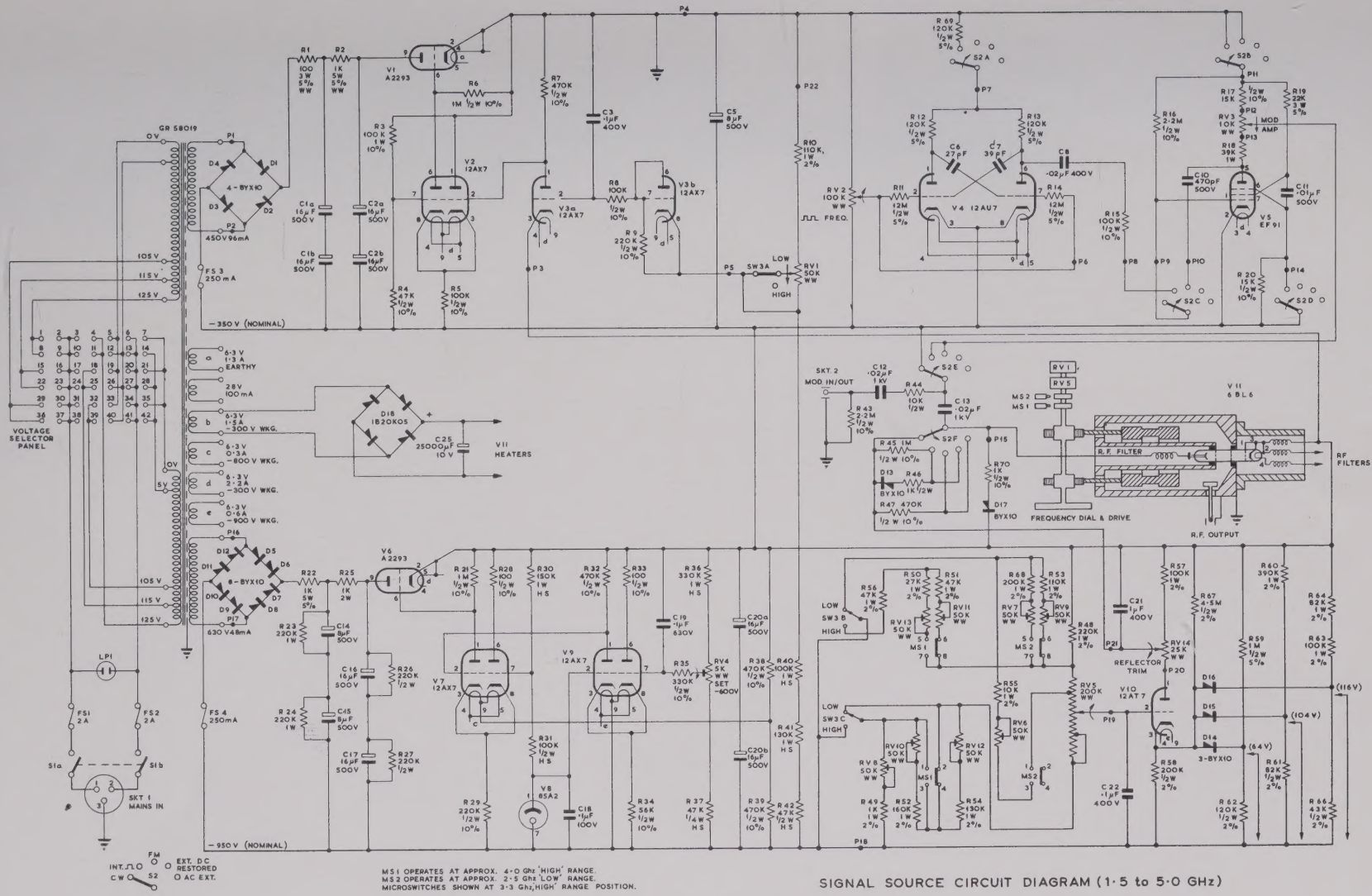
	Supply Input 3 way	Type WK 3-21-C$\frac{5}{16}$	Cannon

12. VOLTAGE SELECTOR

V.S.1.	Supply Selector	Type B 279002/A with Plug	McMurdo

13. INDICATOR LAMP

	Supply Indicator Lamp 100-125V a.c.	AMBER type 82/713	United Carr Fasteners



SIGNAL SOURCE CIRCUIT DIAGRAM (1·5 to 5·0 GHz)

MP MASTER
MA23594

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